DEPARTMENT OF MATHEMATICS

The Department of Mathematics offers a wide variety of majors and minors. In addition to the degree programs described below, many students pursue joint majors in mathematics and other disciplines that utilize mathematics. The most popular of these are mathematics/computer science and mathematics/physics. A joint major is obtained by completing the degree requirements for both majors. Minor programs are described below under “Undergraduate Curricular Requirements.”

At the graduate level, the department offers the M.S., M.A.T., and Ph.D. degrees in mathematics. Graduate training in mathematics prepares students for careers in teaching or research and development. Employment opportunities include universities, colleges, industries, and government agencies. The Ph.D. is generally required for teaching and research at the university level. The M.S. qualifies students to teach at junior colleges, some four-year colleges, and for many positions in industry. The M.A.T. prepares students for secondary teaching and for some junior college positions. A baccalaureate degree in mathematics is generally required for admission to the graduate program; however, many students of science and technology can be admitted to the program with few undergraduate deficiencies.

The need for persons with quantitative skills is increasing dramatically as the world grows more complex. Mathematicians and statisticians have employment opportunities in business, industry, government, and teaching. Training in mathematics, with its emphasis on problem solving, analysis, and critical thinking, is excellent preparation for graduate programs in engineering, science, business, or law. In fact, persons planning careers in almost any field will find their opportunities enhanced by the study of mathematics and statistics. The programs are intended to provide students just such enhancement. It is generally the case that the person who develops his or her quantitative skills has increased ability to attack many of the complex problems of society. Advances in science, technology, the social sciences, business, industry, and government become more and more dependent on precise analysis and the extraction of information from large quantities of data. Environmental problems, for example, require careful analysis by persons (or teams of persons) with skills in mathematics, statistics, and computer science as well as in biology, geology, physics, and many other fields.

The demand for teachers of mathematics is greater now than ever before. Nearly every school district in the nation has a shortage of teachers trained in mathematics. UI offers a broadly based program leading to teacher certification, through enrollment either in the Department of Mathematics or in the College of Education and completion of a major or minor in mathematics.

Mathematics

The body of mathematical knowledge that has grown over the past 2,000 years is a magnificent human achievement, and it is growing more rapidly than ever before. The habits of systematic and creative thought developed in the study of mathematics are recognized as invaluable in most areas of human endeavor. University of Idaho’s B.S. options in mathematics are designed to introduce the student to the excitement of mathematical ideas; they allow the maximum possible freedom to explore those areas of mathematics that the student finds most interesting.

The department has a sound program in mathematics with a proven record of preparing students for successful graduate study at the very best universities in the nation. There are sequences of courses in calculus, advanced calculus, linear algebra, differential equations, number theory, abstract algebra, topology, geometry, statistics, complex analysis, combinatorics, and mathematical analysis. Students of mathematics who do not go to graduate school are well prepared for industrial, governmental, or teaching jobs if they have some additional exposure to computer science, education, or one of the natural, social, or applied sciences.

Applied Mathematics

Many of the greatest achievements in mathematics were inspired by problems in the natural sciences; today mathematics has wide application in both the natural and social sciences. Applied mathematics provides a broad arena for intellectual and creative impulses of people. The applied options in the mathematics B.S. degree allows a choice of the computation, operations research, or scientific modeling, options. Each of these is discussed briefly below. Many students interested in applications of mathematics pursue a joint major in some other department.

Applied - Computation Option

The advent of computers has changed nearly every aspect of society. As computation has become both more important and more feasible, it has inspired the development of several fields of study within mathematics. The computation option of the applied mathematics degree provides training in the mathematics applicable to computer science and technology. Many students pursue this option jointly with a computer science major.

Applied - Mathematical Biology Option

Biology is undergoing an information revolution. Recent technological advances have created an avalanche of biological data and a quantification of biology that has transformed the subject. The manipulation, analysis and interpretation of large, complex datasets is now central to much of biology. Moreover, mathematical models of the dynamics of biological systems can now be put in contact with empirical work in a way that allows a true synthesis of theory and data. This option will provide the needed cross training required for success in careers in mathematical biology.

Applied - Scientific Modeling Option

The role of modeling is essential in modern interdisciplinary research involving mathematics and the sciences. This option gives students an opportunity to learn about mathematical modeling with particular emphasis on the life sciences and the physical sciences. It provides an opportunity for students to create a very strong double major program and provides ideal preparation for future graduate training in the sciences.

Faculty members in the Department of Mathematics will be happy to answer questions about specific programs and courses. Such questions can also be addressed to the department chair (Brink 300; phone 208/885-6742).

Christopher Williams, Interim Dept. Chair (300 Carol Ryrie Brink Hall 83844-1103; phone 208-885-6742; math@uidaho.edu; www.uidaho.edu/Math).

ABBOTT, Ann; 2017; Ann; Instructor in Mathematics; 2002; University of Idaho.
*ABO, Hirotachi; 2006; Associate Professor of Mathematics; Ph.D.; 2002; Saarland University.

ALLEN, Theresa; 2017; Instructor in Mathematics; Ph.D.; 1993; 1993.

*BARANNYK, Lyudmyla; 2007; Associate Professor in Mathematics; Affiliate Faculty in Electrical and Computer Engineering; Ph.D.; 2003; New Jersey Institute of Technology.

*DATTA, Somantika; 2010; Associate Professor of Mathematics; Ph.D.; 2007; University of Maryland.

*ELY, Robert E; 2007; Associate Professor of Mathematics Education; Ph.D.; 2007; University of Wisconsin.

*GAO, Fuchang; 1999; Professor of Mathematics; Affiliate Faculty in Bioinformatics and Computational Biology; Ph.D.; 1999; University of Connecticut.

*JOHNSON-LEUNG, Jennifer M; 2007; Associate Professor of Mathematics; Ph.D.; 2005; California Institute of Technology.

*KRONE, Stephen M; 1995; Professor of Mathematics; Affiliate Faculty in Bioinformatics and Computational Biology; Ph.D.; 1990; University of Massachusetts.

LUONG, Tran Dinh; 2009; Adjunct Assistant Professor of Mathematics; Ph.D.; 2009; University of Idaho.

*NGUYEN, Linh V; 2011; Associate Professor in Mathematics; Ph.D.; 2010; Texas A&M University.

*NIELSEN, Mark J; 1990; Professor of Mathematics; Interim Dean, College of Science; Ph.D.; 1990; University of Washington.

PIEZ, Cynthia M; 1991; Senior Instructor in Mathematics; M.S.; 1990; Northern Arizona University.

*REMIEN, Christopher H; 2014; Assistant Professor of Mathematics; Affiliate Faculty in Biological Sciences, Statistical Science, and Bioinformatics and Computational Biology; Ph.D.; 2012; University of Utah.

*RUDD, Matthew B; 2006; Assistant Professor of Mathematics; Ph.D.; 2003; University of Utah.

TERRIO, Judi; 1994; Lecturer in Mathematics; M.S.; 1998; University of Idaho.

*TOHANEANU, Stefan O; 2013; Assistant Professor of Mathematics; Ph.D.; 2007; Texas A&M University.

TRIGSTED, Kirk C; 1994; Senior Instructor in Mathematics; Director, Polya Math Learning Center; M.S.; 1996; University of Idaho.

*WANG, Hong; 1997; Professor of Mathematics; Ph.D.; 1992; University of Calgary.

*WOO, Alexander K; 2011; Associate Professor in Mathematics; Ph.D.; 2005; University of California Berkeley.

YOPP, David; 2012; Professor of Mathematics; D.A.; 1998; Idaho State University.

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**Majors**

- Mathematics (B.S.) (https://catalog.uidaho.edu/colleges-related-units/science/mathematics/mathematics-bs)

**Minors**


**Mathematics Graduate Program**

Candidates must fulfill the requirements of the College of Graduate Studies and of the Department of Mathematics. See the College of Graduate Studies (https://catalog.uidaho.edu/colleges-related-units/graduate-studies) section for the general university requirements applicable to each degree.

- Mathematics (M.S.) (https://catalog.uidaho.edu/colleges-related-units/science/mathematics/mathematics-ms)
- Mathematics (Ph.D.) (https://catalog.uidaho.edu/colleges-related-units/science/mathematics/mathematics-phd)

**Mathematics**

MATH 108 Intermediate Algebra
**Math 108 Intermediate Algebra (3 cr)**
Carries no credit after Math 137 or 143. Review of algebra including factoring, rational expressions, exponents, radicals, quadratic equations, equations of lines. Taught using the Polya Math Center, a studio environment featuring group study, one-to-one interaction with instructors, computer-mediated modules, and lectures. Does not satisfy general education requirement.

MATH 123 Mathematics Applied to the Modern World
**Math 123 Mathematics Applied To The Modern World (3 cr)**
*Gen Ed: Mathematics*
Discussion of some aspects of mathematical thought through the study of problems taken from areas such as logic, political science, management science, geometry, probability, and combinatorics; discussion of historical development and topics discovered in the past 100 years.

MATH 130 Finite Mathematics
**Math 130 Finite Mathematics (3 cr)**
*Gen Ed: Mathematics*
Systems of linear equations and inequalities, matrices, linear programming, and probability.
**Prereq:** Sufficient score on SAT, ACT, or math placement test; or Math 108 with a "C" or better. Required test scores can be found here: http://www.uidaho.edu/registrar/registration/placement.
MATH 143 Pre-calculus Algebra and Analytic Geometry  
Math 143 Pre-calculus Algebra and Analytic Geometry (3 cr)  
Gen Ed: Mathematics  
Carries no credit after Math 160 or Math 170; carries 2 credits after Math 137. Algebraic, exponential, logarithmic functions; graphs of conics; zeros of polynomials; systems of equations, induction. Taught using the Polya Math Center, a studio environment featuring group study, one-to-one interaction with instructors, computer-mediated modules, and lectures.  
Prereq: Sufficient score on SAT, ACT, or math placement test; or Math 108 with grade of C or better. It is recommended that Math 143 be taken within two years of passing Math 108 or its equivalent. Required test scores can be found here: http://www.uidaho.edu/registrar/registration/placement.  

MATH 144 Analytic Trigonometry  
Math 144 Analytic Trigonometry (1 cr)  
Not open for cr to students who have previously taken Math 137 or higher. Taught using the Polya Math Center, a studio environment featuring group study, one-to-one interaction with instructors, computer-mediated modules, and lectures.  
Prereq: Sufficient score on SAT, ACT, or math placement test. Students may qualify by enrolling concurrently in Math 143 or Math 170. Required test scores can be found here: http://www.uidaho.edu/registrar/registration/placement.  

MATH 160 Survey of Calculus  
Math 160 Survey of Calculus (4 cr)  
Gen Ed: Mathematics  
Carries no credit after Math 170. Overview of functions, and graphs, derivatives, integrals, exponential and logarithmic functions, functions of several variables, and differential equations. Primarily for students who need only one semester of calculus, such as students in business or architecture.  
Prereq: Sufficient score on SAT, ACT, or math placement test, or Math 137 with a C or better, or Math 143 with a C or better. Required test scores can be found here: http://www.uidaho.edu/registrar/registration/placement.  

MATH 170 Analytic Geometry and Calculus I  
Math 170 Analytic Geometry and Calculus I (4 cr)  
Gen Ed: Mathematics  
Carries 2 credits after Math 160. Functions, limits, continuity, differentiation, integration, applications, differential equations, and transcendental functions. Primarily for students in engineering, mathematics, science or computer science.  
Prereq: Math 143 (with a grade of C or better) and Math 144 (concurrent enrollment in Math 144 is allowed although it is recommended that students complete Math 144 before enrolling in Math 170); or demonstrated proficiency through a sufficiently high score on the ACT, SAT, or math placement test. Required test scores can be found here: http://www.uidaho.edu/registrar/registration/placement.  

MATH 175 Analytic Geometry and Calculus II  
Math 175 Analytic Geometry and Calculus II (4 cr)  
Gen Ed: Mathematics  
Differentiation and integration of transcendental functions, integration techniques, general mean value theorem, numerical techniques, and series.  
Prereq: Math 170 with a grade of C or better.  

MATH 176 Discrete Mathematics  
Math 176 Discrete Mathematics (3 cr)  
Induction, set theory, graph theory, number systems, Boolean algebra, and elementary counting.  
Prereq: Math 143 or sufficiently high score on SAT, ACT, or math placement test. Required test scores can be found here: http://www.uidaho.edu/registrar/registration/placement.  

MATH 204 (s) Special Topics  
Math 204 (s) Special Topics (cr arr).  
MATH 215 Proof via Number Theory  
Math 215 Proof via Number Theory (3 cr)  
An introduction to mathematical thinking and proof through the development of the basic results of elementary number theory. Emphasis on techniques of mathematical proofs, reading and writing proofs, and fundamental mathematical structures.  
Prereq: Math 175 and Math 176.  

MATH 275 Analytic Geometry and Calculus III  
Math 275 Analytic Geometry and Calculus III (3 cr)  
Gen Ed: Mathematics  
Vectors, functions of several variables, and multiple integration.  
Prereq: Math 175.  

MATH 299 (s) Directed Study  
Math 299 (s) Directed Study (cr arr).  
MATH 310 Ordinary Differential Equations  
Math 310 Ordinary Differential Equations (3 cr)  
Classification, initial and boundary value problems of one variable, exact equations, methods of solving higher-order linear equations, second-order equations with constant coefficient, series solutions, systems of linear equations, Laplace transforms, and existence theorems. Recommended preparation: Math 275.  
Prereq: Math 175.  

MATH 315 HON:Topics in Pure Mathematics  
Math H315 Topics in Pure Mathematics (3 cr)  
A topic selected each yr that develops skill and appreciation for theoretical nature of mathematics.  
Prereq: Permission of director of University Honors Program.  

MATH 326 Linear Optimization  
Math 326 Linear Optimization (3 cr)  
Geometric solutions, simplex method, duality and revised simplex method, sensitivity, integer programming, applications. Recommended Preparation: Math 175.  
Prereq: Math 160 or 170.  

MATH 330 Linear Algebra  
Math 330 Linear Algebra (3 cr)  
Linear equations, matrices, linear transformations, eigenvalues, diagonalization; applications. Recommended Preparation: Math 175.  
Prereq: Math 160 or 170.  

MATH 371 Mathematical Physics  
Math 371 Mathematical Physics (3 cr)  
See Phys 371.  

MATH 376 Discrete Mathematics II  
Math 376 Discrete Mathematics II (3 cr)  
Selected topics from discrete mathematics such as graph theory, modeling, and optimization. Recommended for computer science majors.  
Prereq: Math 176 or Permission.
MATH 385 Theory of Computation
Math 385 Theory of Computation (3 cr)
Same as CS 385. Mathematical models of computation, including finite automata and Turing machines. (Fall only)
Prereq: Permission.

MATH 386 Theory of Numbers
Math 386 Theory of Numbers (3 cr)
Second course on number theory, including a historical treatment of efforts to answer basic questions on the density and possible forms of prime numbers. Topics may include: quadratic reciprocity, cubic reciprocity, quadratic forms, genus theory, higher reciprocity laws, Hilbert class field, the prime number theorem, Dirichlet's theorem on primes in an arithmetic progression, elliptic curves, and modular forms.
Prereq: Math 215.

MATH 388 History of Mathematics
Math 388 History of Mathematics (3 cr)
Same as Hist 388. History of the development of mathematical ideas from ancient cultures to the present, including the relationship of those ideas to the cultures that produced them as well as an understanding of the mathematics involved. Cooperative: open to WSU degree-seeking students.
Prereq: Math 175 or Permission.

MATH 390 Axiomatic Geometry
Math 390 Axiomatic Geometry (3 cr)
Development of Euclidean and hyperbolic geometry using the axiomatic approach. Recommended Preparation: Math 215.
Prereq: High school geometry and Math 176, or Instructor Permission.

MATH 391 Modern Geometry
Math 391 Modern Geometry (3 cr)
Euclidean and non-Euclidean geometries, plus topics chosen from projective, transformational, and computational geometry. Recommended Preparation: Math 215.
Prereq: High school Geometry and Math 176, or Instructor Permission.

MATH 395 Analysis of Algorithms
Math 395 Analysis of Algorithms (3 cr)
Same as CS 395. Measures of efficiency; standard methods and examples in the design, implementation, and analysis of algorithms. (Spring only)
Prereq: Math 175 and CS 121.

MATH 400 (s) Seminar
Math 400 (s) Seminar (cr arr).

MATH 404 (s) Special Topics
Math 404 (s) Special Topics (cr arr).

MATH 415 Cryptography
Math 415 Cryptography (3 cr)
Gen Ed: Senior Experience
Congruences, modular arithmetic, private-key cryptosystems, public-key cryptosystems, and applications. The role of modern mathematics in information age society.
Prereq: Math 330.

MATH 420 Complex Variables
Math 420 Complex Variables (3 cr)
Complex numbers, elementary functions, derivatives, the residue theorem, conformal mappings, contour integration, infinite series, applications.
Prereq: Math 275.

MATH 426 Discrete Optimization
Math 426 Discrete Optimization (3 cr)
Optimization on graphs, networks and flows, and related topics. Recommended Preparation: Math 175.

MATH 427 Transformational Geometry
Math 427 Transformational Geometry (3 cr)
See MthE 527.

MATH 428 Numerical Methods
3 credits
Cross-listed with ENGR 428, PHYS 428
Systems of equations, root finding, error analysis, numerical solution to differential equations, interpolation and data fitting, numerical integration, related topics and applications.
Prereq: MATH 310.

MATH 430 Advanced Linear Algebra
Math 430 Advanced Linear Algebra (3 cr)
Vector spaces, linear transformations, characteristic polynomial, eigenvectors, Hermitian and unitary operators, inner products, quadratic forms, Jordan canonical form, applications.
Prereq: Math 215 and Math 330 or Instructor Permission.

MATH 432 Numerical Linear Algebra
Math 432 Numerical Linear Algebra (3 cr)
Analysis of efficiency and accuracy of large linear algebra problems; special emphasis on solving linear equations and finding eigenvalues.
Prereq: Math 275, 330, and knowledge of a computer language.

MATH 437 Mathematical Biology
Math 437 Mathematical Biology (3 cr)
Modeling biological phenomena, mostly through differential equations; mathematical topics include stability analysis and limit cycles for nonlinear ODE’s, spatial diffusion and traveling waves for PDE’s; biological topics include models of predator-prey systems, infectious diseases, and competition. Cooperative: open to WSU degree-seeking students.
Prereq: Math 310 or Permission.

MATH 438 Mathematical Modeling
Math 438 Mathematical Modeling (3 cr)
Topics in the use of mathematics to model phenomena from science, business, economics, and engineering.
Prereq: CS 120, Math 310 and Math 330, or Instructor Permission.

MATH 451 Probability Theory
3 Credits
Cross-listed with STAT 451
Random variables, expectation, special distributions (normal, binomial, exponential, etc.), moment generating functions, law of large numbers, central limit theorem. Cooperative: open to WSU degree-seeking students. (Fall only)
Prereq: MATH 275, or Permission
Coreq: MATH 275.

MATH 452 Mathematical Statistics
3 credits
Cross-listed with STAT 452
Estimation of parameters, confidence intervals, hypothesis testing, likelihood ratio test, sufficient statistics. Cooperative: open to WSU degree-seeking students. (Spring only)
Prereq: MATH 451 or Permission.

MATH 453 Stochastic Models
3 credits
Joint-listed with MATH 538, Cross-listed with STAT 453
Markov chains, stochastic processes, and other stochastic models; applications. Additional projects/assignments required for graduate credit. Cooperative: open to WSU degree-seeking students.
Prereq: MATH 451 or Permission.
MATH 455 Applied Actuarial Science
Math 455 Applied Actuarial Science (1 cr)
Risk problems on the actuarial exam. Graded P/F.
Prereq: Math 451.

MATH 461 Abstract Algebra I
Math 461 Abstract Algebra I (3 cr)
Groups, rings, and fields. (Fall only)
Prereq: Math 215 and Math 330; or Permission.

MATH 462 Abstract Algebra II
Math 462 Abstract Algebra II (3 cr)
Groups, rings, and fields. (Spring only)
Prereq: Math 461.

MATH 471 Introduction to Analysis I
Math 471 Introduction to Analysis I (3 cr)
Topology of Euclidean n-space, limit and continuity, differentiation, integration. (Fall only)
Prereq: Math 275 and Math 215; or Permission.

MATH 472 Introduction to Analysis II
Math 472 Introduction to Analysis II (3 cr)
Topology of Euclidean n-space, limit and continuity, differentiation, integration. (Spring only)
Prereq: Math 471 or Permission.

MATH 476 Combinatorics
Math 476 Combinatorics (3 cr)
Elementary counting methods, generating functions, recurrence relations, Polya's enumeration, enumeration of graphs, trees, searching, combinatorial algorithms. Recommended Preparation: Math 176, or 215, or 376.
Prereq: Math 175 and 330.

MATH 480 Partial Differential Equations
Math 480 Partial Differential Equations (3 cr)
Intro to Fourier analysis, application to solution of partial differential equations; classical partial differential equations of engineering and physics.
Prereq: Math 275 and Math 215; or Permission.

MATH 494 Seminar in Mathematical Biology
Math 494 Seminar in Mathematical Biology (1 cr)
Oral presentation of research approaches, research results and literature review of mathematical biology including mathematical modeling of biological systems. Cooperative: open to WSU degree-seeking students.

MATH 499 (s) Directed Study
Math 499 (s) Directed Study (cr arr).

MATH 500 Master's Research and Thesis
Math 500 Master's Research and Thesis (cr arr).

MATH 501 (s) Seminar
Math 501 (s) Seminar (cr arr).

MATH 502 (s) Directed Study
Math 502 (s) Directed Study (cr arr).

MATH 504 (s) Special Topics
Math 504 (s) Special Topics (cr arr).

MATH 505 (s) Professional Development
Math 505 (s) Professional Development (cr arr)
Cr earned in this course will not be accepted toward grad degree programs.
Prereq: Permission.

MATH 510 Seminar on College Teaching of Mathematics
Math 510 Seminar on College Teaching of Mathematics (1 cr)
Development of skills in the teaching of college mathematics; includes structure of class time, test construction, and various methods of teaching mathematics; supervision of teaching assistants in their beginning teaching assignments. Graded P/F.
Prereq: Permission.

MATH 521 Topology I
Math 521 Topology I (3 cr)
Basic concepts of point set and algebraic topology. Cooperative: open to WSU degree-seeking students.

MATH 522 Topology II
Math 522 Topology II (3 cr)
Basic concepts of point set and algebraic topology.

MATH 523 Algebraic Topology I
Math 523 Algebraic Topology I (3 cr)
Basic homotopy theory, covering spaces, homology theory, and applications.

MATH 528 Differentiable Manifolds
Math 528 Differentiable Manifolds (3 cr)
Fundamentals of smooth manifolds, tangent spaces, vector fields, Lie groups, integration on manifolds, and applications. Cooperative: open to WSU degree-seeking students.
Prereq: Math 521 and Math 472.

MATH 529 Numerical Methods
3 credits
Cross-listed with MATH 529
Systems of equations, root finding, error analysis, numerical solution to differential equations, interpolation and data fitting, numerical integration, related topics and applications. Additional projects and/or assignments required for graduate credit in PHYS 528.
Prereq: MATH 310.

MATH 531 Complex Variables
Math 531 Complex Variables (3 cr)
Theory of functions of a complex variable. Cooperative: open to WSU degree-seeking students.

MATH 535 Real Variables
Math 535 Real Variables (3 cr)
Measure and integration theory for functions of one or several variables.

MATH 538 Stochastic Models
3 credits
Joint-listed with MATH 453, Cross-listed with STAT 544
Markov chains, stochastic processes, and other stochastic models; applications. Additional projects/assignments required for graduate credit.
Cooperative: open to WSU degree-seeking students.
Prereq: MATH 451 or Permission.

MATH 539 Theory of Ordinary Differential Equations
Math 539 Theory of Ordinary Differential Equations (3 cr)
Existence, uniqueness, and stability of solutions of first-order systems; other topics. Cooperative: open to WSU degree-seeking students.

MATH 540 Partial Differential Equations
Math 540 Partial Differential Equations (3 cr)
Existence and uniqueness theorems for the wave, heat, and Laplace's equations of physics; additional topics such as nonlinear models in mathematical biology, perturbation methods, etc. Cooperative: open to WSU degree-seeking students.
Prereq: Math 539 or Permission.
MATH 541 (s) Seminar in Analysis
Math 541 (s) Seminar in Analysis (1-3 cr, max arr)
Current literature. Cooperative: open to WSU degree-seeking students.

MATH 555 Groups and Fields I
Math 555 Groups and Fields I (3 cr)
Groups, fields, polynomials, Galois theory, representation theory. Cooperative: open to WSU degree-seeking students.
Prereq: Math 461 and Math 462; or equivalent.

MATH 556 Groups and Fields II
Math 556 Groups and Fields II (3 cr)
Groups, fields, polynomials, Galois theory, representation theory. Cooperative: open to WSU degree-seeking students.
Prereq: Math 555 or Permission.

MATH 557 Ring Theory
Math 557 Ring Theory (3 cr)
Rings, ideals, modules, commutative algebra. Cooperative: open to WSU degree-seeking students.
Prereq: Math 461 and Math 462; or equivalent.

MATH 558 Introduction to Algebraic Geometry
Math 558 Introduction to Algebraic Geometry (3 cr)
Affine and projective varieties, morphisms, functions on varieties, birational maps, applications. Cooperative: open to WSU degree-seeking students.
Prereq: Math 557 or Permission.

MATH 561 (s) Seminar In Algebra
Math 561 (s) Seminar in Algebra (1-3 cr, max arr)
Current literature.

MATH 563 Mathematical Genetics
3 credits
Cross-listed with BIOL 563 Investigation of aspects of evolutionary biology with an emphasis on stochastic models and statistical methods; topics include: diffusion methods in molecular evolution, gene genealogies and the coalescent, inferring coalescent times from DNA sequences, population subdivision and F statistics, likelihood methods for phylogenetic inference, statistical hypothesis testing, the parametric bootstrap. Cooperative: open to WSU degree-seeking students.
Prereq: Math 160 or MATH 170 and STAT 251 or STAT 301.

MATH 571 Functional Analysis I
Math 571 Functional Analysis I (3 cr)
Linear topological spaces and linear operators.
Prereq: Math 535.

MATH 572 Functional Analysis II
Math 572 Functional Analysis II (3 cr)
Linear topological spaces and linear operators.
Prereq: Math 571.

MATH 575 Graph Theory I
Math 575 Graph Theory I (3 cr)
Basic concepts and theorems; topics include trees and connectivity, eulerian and hamiltonian graphs, graph colorings, matchings, graph decomposition, and extremal graph theory.

MATH 576 Graph Theory II
Math 576 Graph Theory II (3 cr)
Basic concepts and theorems; topics include trees and connectivity, eulerian and hamiltonian graphs, graph colorings, matchings, graph decomposition, and extremal graph theory.
Prereq: Instructor Permission.

MATH 579 Combinatorics
Math 579 Combinatorics (3 cr)
Topics from enumerative combinatorics, design theory, extremal combinatorics and algebraic combinatorics.

MATH 596 MAT Comp Exam
Math 596 MAT Comp Exam (1 cr)
Supervised preparation for the Master of Arts in Teaching comprehensive exam. Graded Pass/Fail.

MATH 598 (s) Internship
MATH 598 (s) Research
Math 599 (s) Non-thesis Master's Research (cr arr)
Research not directly related to a thesis or dissertation.
Prereq: Permission.

MATH 600 Doctoral Research and Dissertation
Math 600 Doctoral Research and Dissertation (cr arr).

Mathematics Education

MTHE 235 Mathematics for Elementary Teachers I
3 credits
Mathematical development of arithmetic and problem solving as those subjects are currently taught in elementary schools. Three lec and one 1-hr lab a wk.
Prereq: MATH 137 or MATH 143 or sufficient score on SAT, ACT, or COMPASS Math Test.

MTHE 236 Mathematics for Elementary Teachers II
3 credits
Mathematical development of informal geometry, problem solving, and probability and statistics as those subjects are currently taught in elementary schools. Three lec and one 1-hr lab a wk.
Prereq: MTHE 235.

MTHE 301 Early Childhood Mathematics
4 credits
Focus on the mathematics for early childhood: numbers and operations, algebraic thinking, geometry, measurement, probability and statistics. Emphasis will be placed on reasoning, representation, connections and communication. This course is restricted to students from either the School of Family and Consumer Sciences or the College of Education. This course will not count as a 300-level mathematics course in any major or minor in the College of Science. Recommended preparation: STAT 150.
Prereq: One general education math course.

MTHE 303 Early Childhood Math I
2 credits
Focus on the mathematics of early childhood: numbers and operations. Emphasis is placed on reasoning, representation, connections and communication. This course is restricted to students from either the School of Family and Consumer Sciences or the College of Education. This course will not count as a 300-level mathematics course in any major or minor in the College of Science. Recommended preparation: general education math course.

MTHE 304 Early Childhood Math II
2 credits
Focus on the mathematics of early childhood: algebraic reasoning, geometry, measurement, probability and statistics. Emphasis is placed on reasoning, representation, connections and communication. This course is restricted to students from either the School of Family and Consumer Sciences or the College of Education. This course will not count as a 300-level mathematics course in any major or minor in the College of Science. Recommended preparation: general education math course.
**MTHE 409 Algebraic and Functional Reasoning**  
3 credits  
Examines the understandings that are foundational to advanced algebraic concepts, and how grade 5-10 students develop these ideas. Topics include strategies for solving equations and systems, covariational reasoning, properties of linear, quadratic, exponential, and trigonometric functions.

**MTHE 410 Proof and Viable Argumentation**  
3 credits  
Develops viable argumentation as it can be found in grades 5-10 as a means of learning content, deepening understanding, and determining what is true and what is false mathematically. Topics include the language of argumentation, argument types, reasoning types, the distinction between proofs and viable arguments. Emphasizes how different argument types can contribute to student learning and increasing student discourse.

**MTHE 513 Problem Solving Through History**  
3 credits  
Historical study of approaches to solving problems in geometry, number theory, and set theory. This course is specifically designed for the MAT program, and will not satisfy the requirements of other mathematics degree programs.

**MTHE 514 Foundations of Calculus**  
3 credits  
Real numbers, sequences, topology of the real numbers, continuous functions, differentiation, and integration; emphasis on developing the conceptual understanding needed to teach calculus in secondary school. This course is specifically designed for the MAT program, and will not satisfy the requirements of other mathematics degree programs.

**MTHE 515 Problems in Geometry**  
3 credits  
Exploration of topics in geometry with emphasis on developing geometric reasoning and problem solving. This course is specifically designed for the MAT program, and will not satisfy the requirements of other mathematics degree programs.

**MTHE 516 Groups and Symmetry**  
3 credits  
Exploration of groups, symmetry, and permutations. This course is specifically designed for the MAT program, and will not satisfy the requirements of other mathematics degree programs.

**MTHE 519 (s) Special Topics**  
Credit arranged  
Special topics of interest to mathematics teachers. This course is specifically designed for the MAT program, and will not satisfy the requirements of other mathematics degree programs.  
Prereq: Permission.

**MTHE 527 Transformational Geometry**  
3 credits  
Same as Math 427. Geometry concepts of congruence, parallelism, and similarity using rigid motions; the group structure of the collection of isometries and their matrix representations. For graduate credit, additional transformational approaches for calculus integration strategies are required. The course is of particular interest to secondary mathematics teaching majors.  
Prereq: MATH 330 or equivalent.

**MTHE 590 Seminar in Math Education**  
1-3 credits, max arranged  
Topics in Mathematics Education. May be repeated for credit. Cooperative: open to WSU degree-seeking students.